Oscilloscope and Function Generator for the PC

test equipment with Centronics interface

Review by Harry Baggen

Many readers are undoubtedly familiar with the company name Velleman, because of their electronics kits. Their range of products encompasses a wider range however; several different types of test equipment are also available. We subjected two such instruments to closer scrutiny: a digital storage oscilloscope and a function generator for the PC.

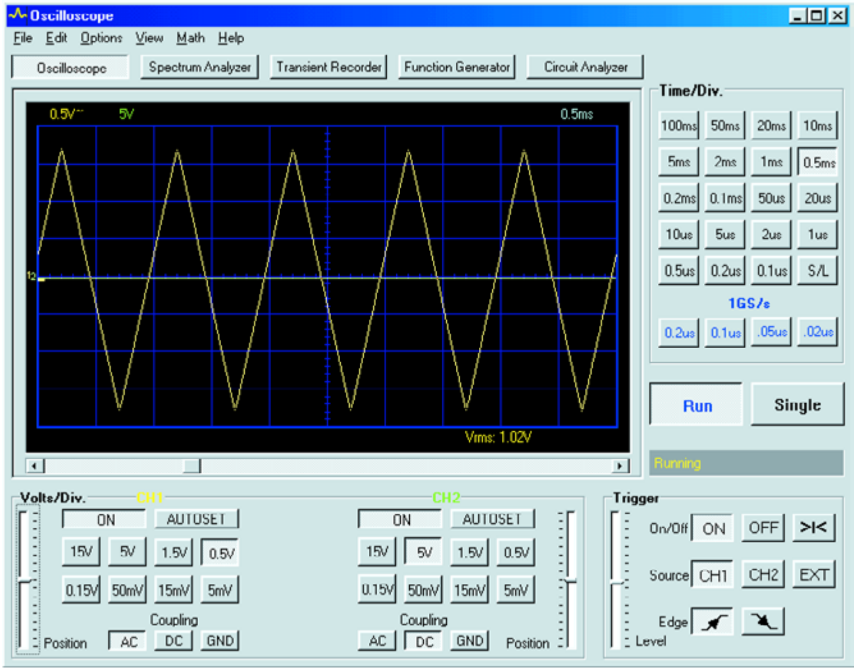


Figure 1. The oscilloscope window offers all the adjustment options of a real two-channel scope.

As already mentioned in the introduction, the name Velleman is practically synonymous with well thought out electronics kits dirtributed through a wide network of electronics retailers. But the product range hasn't been limited to kits for a considerable time now. The assortment is very extensive and just about anything that is remotely related to electronics can be supplied, from disco mirror balls to right up to advanced test equipment. It is from the latter category that we will examine a couple of instruments a little bit closer.

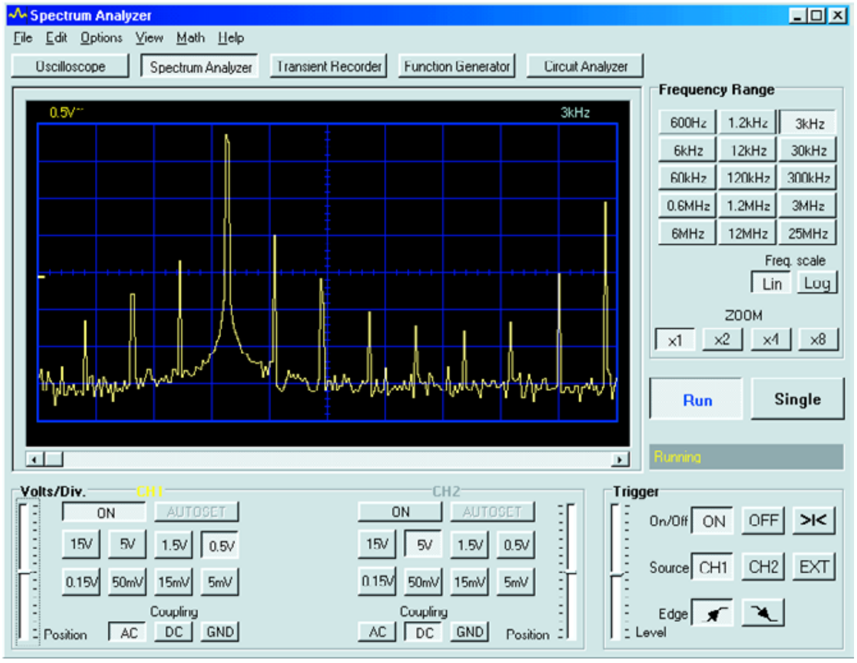


Figure 2. The spectrum analyser shows the frequency components of the input signal.

The equipment under evaluation is a **Function Generator PCG10** (also available as kit K8016) and a **Digital Storage Oscilloscope PCS500** (a single-channel version comes as kit K8031). Both instruments are intended for use in conjunction with a PC. Consequently, they are not much more than small grey boxes with a few connectors. Operation and read-out takes place entirely on the computer display. For this purpose, both devices are fitted with an optically isolated Centronics interface. In order to be able to use both instruments at the same time (which is rather likely) the function generator is fitted with a pass-through connector, so that both devices can be connected to a single Centronics port.

First, the most important specifications:

PC Function Generator PCG10

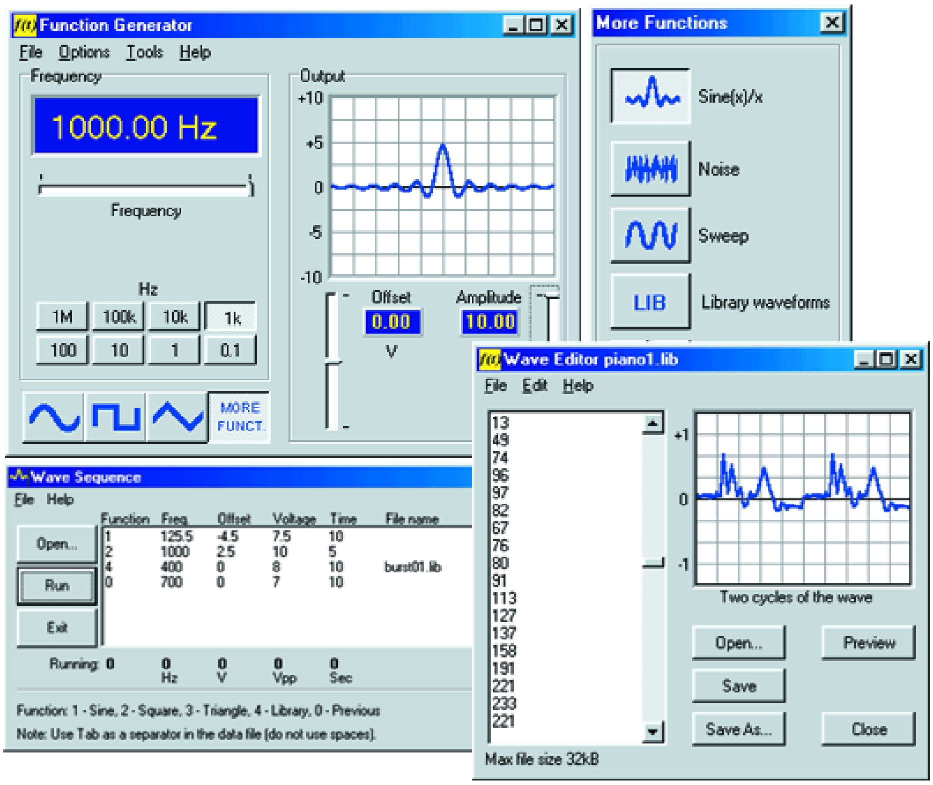
- frequency range 0 to 1 MHz
- direct digital synthesis (DDS) with 32 k waveform-memory, sampling frequency 32 MHz
- accuracy of selected frequency: 0.01%
- output amplitude: 0.1 to 10 V_{pp} (50 Ω output impedance)
- offset adjustment –5 to +5 V
- waveform resolution: 8 bits
- waveforms: sine, square, triangle and user-defined
- output filter can be deactivated

Digital Storage Oscilloscope PCS500

- time base 100 ms to 10 ns/div
- input sensitivity 5 mV to 15 V/div
- sampling frequency 50 MHz
- sampling frequency for repetitive signals: 1 GHz
- extensive triggering capabilities (edge, level, source)
- autoset and pre-trigger function
- markers for time, frequency and voltage
- linear or smoothed interpolation
- record length 4,096 samples/channel
- additional functions: spectrum analyser and transient recorder.

In practice

Both instruments were connected to a rather old Pentium PC in order to examine their capabilities in actual use. Since you need to have a spare Centronics port available, you will either have to connect the printer to the USB port, or fit an additional PCI expansion card with a second Centronics port. It is a pity that this test equipment does not make use of the USB port. This would have been much easier (perhaps a suggestion for the next generation?).



Function	Freq	Offset	Voltage	Time	File name
1	125.5	-4.5	7.5	10	
2	1000	2.5	10	5	
4	400	0	8	10	burst01.lib
0	700	0	7	10	

Running: 0 0 Hz 0 V 0 Vpp 0 Sec

Function: 1 - Sine, 2 - Square, 3 - Triangle, 4 - Library, 0 - Previous

Note: Use Tab as a separator in the data file (do not use spaces).

Figure 3. The generator has several extras, such as a number of pre-programmed waveforms, a waveform-sequencer and a waveform-editor.

The instruments may now be connected. The signal generator is connected to the PC first. Next, the oscilloscope is connected to the signal generator. All the necessary cables are supplied. Pay attention when connecting the mains adapters. The oscilloscope operates from 9 V and the signal generator from 12 V! We didn't dare to find out whether or not something fails if they are reversed!

The accompanying PC-Lab 2000 program can now be installed. This program is compatible with most versions of Windows and the installation on our test computer was completed without problems. Also, the most recent version can always be obtained from the Velleman website.

After starting the program a setup window appears. Here you have to tick the boxes for the equipment that is connected and indicate the address of the printer port that has been used. Once this is completed, the oscilloscope window appears on the screen.

The test cables that were supplied with the unit will suffice for an initial evaluation. However, for 'real' measurements we would like to suggest that you obtain some authentic oscilloscope probes, because the supplied test cables are not much more than a piece of cable with two croc clips.

After connecting a signal and clicking the Autoset button, the 'scope immediately produced a usable picture. Both the input sensitivity and the time scale are automatically adjusted with this function, resulting in a good readable signal that is displayed over several periods. Naturally, many things can also be adjusted by hand, just like the buttons on a normal oscilloscope. Because of the storage function, single-shot signals can easily be recorded and displayed. The markers are very useful in practice, as well as the ability to display the effective value or dBm value of the signal in the oscilloscope window.

The four fastest time settings, 200 ns/div to 20 ns/div, are unfortunately only of limited use, because a method is used where a periodic signal is sampled at different points. In this way a pseudo sampling rate of 1 GHz is obtained. Note, however, that this method is only useful if the signal does not change. And who can be sure of that?

Using the normal sampling frequency of 50 MHz, the scope is usable to about 5 or 10 MHz, depending on the degree of accuracy required to make a proper judgement of the waveform.

With the click of a button, a change can be made to the spectrum-analyser window. This provides an impression of the frequency components of a signal, so that, for example, distortion components can be examined. Regrettably, there are several details that make this feature less user-friendly. The division of the frequency scale is rather strange (multiples of 3 and 12, while one would expect 3 and 10, because there are actually 10 divisions displayed on the screen). The vertical scale is even more awkward. It cannot be changed to a logarithmic scale, which is particularly useful in an FFT plot. It is, however, possible to select a logarithmic scale for the horizontal axis. Despite all this, there are many nice features, such as the choice of FFT window and very useful markers (which do show the level in dB!).

The transient recorder is another function that can be invoked. This is very similar to the oscilloscope window, but the time scale is much longer (up to 2000 s/div). This way, very slowly varying processes can be traced (more than a year is possible).

The measured oscilloscope samples can be stored in a text file and may be retrieved later for viewing on the display.

A separate window is opened for the operation of the function generator. This not only provides the opportunity to adjust the output amplitude, shape and frequency, but also shows a preview of the waveform. The controls are conveniently arranged and the frequency can be adjusted quickly with a slider or by typing in the exact value. The output amplitude and offset are adjusted in a similar manner. In addition to the three waveform buttons, there is the button 'More funct.' This offers a selection between sin(x)/x-function, noise, a frequency sweep and a number of waveforms from the library. With the help of a separate editor, the user can also define waveforms for themselves.

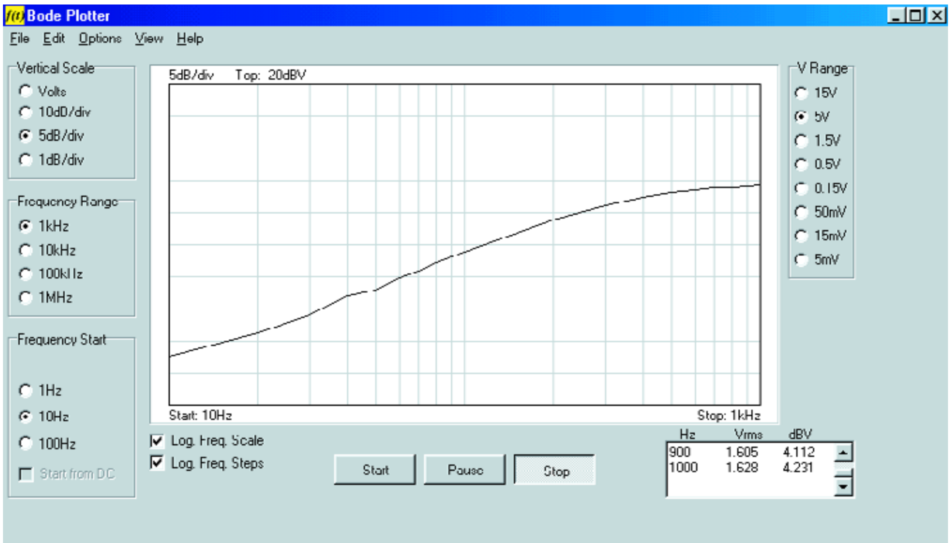
Unfortunately, the frequency range of the generator is rather limited; the maximum value is only

1 MHz. This is caused by the technique used for generating the waveforms. The direct digital synthesis implemented here requires a relatively high sample frequency (32 MHz in this case). At higher output frequencies this also needs to be proportionally higher. The advantages of this instrument are unquestionably the high accuracy of the output frequency, the flexible output signal with many waveforms and the programmability.

Users will have to be aware that the generator window cannot be closed during use. If this is done, the signal generator is switched off and the signal disappears. Our tip: keep an eye on the Ready LED on the generator, because it is illuminated when an output signal is present.

A very nice test configuration that can be realised with the combination of the instruments described here is a Bode Plotter. It is very easy to measure the transfer function of a filter or amplifier by simply connecting the output of the generator to the input, and the input of the scope to the output of the circuit to be measured. From here, having set the frequency range and sensitivity, everything is done nearly automatically. It is possible to select a logarithmic scale for either the amplitude and the frequency, or both — very practical!

An interesting new feature in the latest version of the software is the possibility of controlling the generator with a text file you create yourself or externally via the RS232 input of the computer.



Vertical Scale: ○ Volts ○ 10dD/div ● 5dB/div ○ 1dB/div

Frequency Range: ● 1kHz ○ 10kHz ○ 100kHz ○ 1MHz

Frequency Start: ○ 1Hz ● 10Hz ○ 100Hz ☐ Start from DC

V Range: ○ 15V ● 5V ○ 1.5V ○ 0.5V ○ 0.15V ○ 50mV ○ 15mV ○ 5mV

5dB/div Top: 20dBV

Start: 10Hz Stop: 1kHz

☑ Log. Freq. Scale

☑ Log. Freq. Steps

Hz	Vrms	dBV
900	1.605	4.112
1000	1.628	4.231

Figure 4. With the aid of the Bode-plotter it is very easy to determine the transfer function of a circuit.

Prices (E&OE):

PCG10 PC Function Generator:	€ 179.95*.
K8016 PC Function Generator (kit):	€ 136.22 / £99.99 (Maplin).
PCS500A 2-Channel 50 MHz PC Oscilloscope:	€ 495.00*.
K8031 1-Channel 12 MHz PC Oscilloscope (kit):	€ 119.95 / £89.99 (Maplin).

* item not listed by Maplin, see www.maplin.co.uk.

Conclusion

Those of you who would like to use their PC for making electronic measurements will make a significant step in the right direction with the test equipment described here. This equipment is also very suitable for measurements 'in the field' when combined with a Notebook computer. The transient recorder in particular can prove to be very useful. However, there has to be a power outlet nearby to supply the various devices.

The function generator does an excellent job and has many features, despite the fact that the frequency range is rather limited. It will depend on the application whether this is sufficient.

On the other hand, the bandwidth of the oscilloscope will probably be sufficient for most applications, but we would wish for some improvements in the spectrum analyser software. Velleman informed us that improved versions of the software are being developed, also as a consequence of user requests.

Overall, this is quite an attractive set of test equipment. Unfortunately, the price of the oscilloscope in particular is fairly high. Not so much in comparison with competing PC-scope products, but this amount of money will also buy you a nice 'hardware' oscilloscope. For the current price of the PCS500 we would really have expected to see two real oscilloscope probes included in the package. For those with lesser demands, the single-channel 'scope K8031 is available. This one is much cheaper but also has a much lower sampling frequency. And finally, dear developers from Velleman, perhaps use the USB port next time? This provides much greater flexibility and leaves the sole Centronics port on the PC available for the printer. Finally, please not that at the time of writing this article, the ready-made units PCG10 and PCS500A were not listed by Maplin, the UK distributor of Velleman kits.

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Further information:

www.velleman.be
Updates and a demo of the PC-Lab 2000 program are available from
www.velleman.be/company/download.asp